TECHNICAL NOTES.

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.



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## THE TILTING MANOMETER.

By

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Aerodynamical Laboratory, N. A. C. A.,
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The following is a description of a tilting manometer designed by the technical staff of the National Advisory Committee for Aeronautics to meet the requirements of a manometer for use in the Wind Tunnel of the Langley Memorial Aeronautical Laboratory.

This gauge was designed to meet the requirements of a manometer for use in connection with a static pressure plate, to indicate the wind speed in the tunnel. These requirements are: first, that the sensitivity of the gauge may be made inversely proportional to the pressure to be measured; second, that the gauge may be accurately and quickly set for any desired pressure; and third, that when set at the desired pressure the extent of variation between the existing and the desired pressures may be readily estimated. As the pressure measured between the static plate in the tunnel wall, and the air

in the tunnel building is not a simple function of the air speed, it is usual to calibrate the readings of such pressure gauges against actual air speed or impact pressure readings from a pitot tube placed in the center of the air stream. Because of this method of arbitrary calibration, it is not essential that the pressure gauge should be adapted to reading absolute pressure values, although this can be easily computed from the angles in the present gauge.

The mechanical construction of the gauge is readily seen from the drawing. The cylindrical alcohol reservoir A is machined in one extremity of the aluminium arm B which is arranged to swing about the center C over the graduated sector D. A glass tube leads from the center of the reservoir to the opposite extremity of the arm, passing through the axis of rotation. The sector is graduated in degrees, the zero graduation corresponding to a 3-1/2° inclination of the tube from the horizontal, which is found to be the lowest angle to give a good meniscus of the alcohol. The upper end of the glass tube is connected to the static pressure plate on the tunnel wall while the air in the reservoir is subjected to the pressure outside of the tunnel. The reservoir is fitted with filling plugs and zero adjustment screw. In setting up the gauge alcohol is poured in with the scale at zero until the meniscus rises to a reference line at C, the

center of rotation. In use the arm is set at an angle, determined from the calibration chart, corresponding to the desired air speed. The propeller is then operated at a speed such that the alcohol again rises to the reference mark.

It will be seen by a moment's consideration that the absolute head may be represented by:

$$h = \ell \sin (\alpha + 3\tfrac{1}{2}^{\circ}) - h_1$$

where h is head of alcohol, $\ell$ is the distance from the center of reservoir to center of rotation, and $h_1$ is the vertical distance from the center of the reservoir to the surface of the contained liquid ($h_1 = \ell \sin 3\tfrac{1}{2}^{\circ}$ = constant); and that the sensitivity, considering a vertical tube as having unit sensitivity, is $\frac{1}{\sin \alpha}$, thus satisfactorily approaching the sensitivity requirements except for the very lowest pressures.

In order that the gauge may be set quickly to any given speed after calibration a number of adjustable stops are placed along the scale at every ten miles per hour so that the arm can be easily snapped into the correct position.

This manometer is quick to adjust, is easy to read, always has the meniscus in the same position, and accurately indicates a large range of air speeds in a comparatively compact instrument.

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